Roaring Run Bowstring Truss Bridge
Spanning the Roaring Run
Route 637
Bedford Vicinity
Bedford County
Virginia

HAER No. VA-7

REDUCED COPIES OF MEASURED DRAWINGS

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
National Park Service
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HISTORIC AMERICAN ENGINEERING RECORD

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ROARING RUN BOWSTRING TRUSS BRIDGE

Date:	Originally built; 1877-1878 Moved to present site; 1930's
Location:	Spanning the Roaring Run, Route 637, Bedford Vicinity Bedford County, Virginia.
Built by:	King Iron Bridge Company, Cleveland, OH
Significance:	Roaring Run is one of the oldest surviving bridges of its type (Bowstring Truss Bridge) in the United States.
Transmitted by:	Dan Clement, 1983

The Roaring Run Bowstring Arch Truss Bridge is among the oldest surviving bridges of this type in the United States. Presently located 5 miles east of Bedford VA adjacent to VA Rt. 637 the bridge was originally built in 1877-78 over Stoney Fork, north of Moneto in Bedford Co.[1] officials of the Virginia Highway and Transportation Research Council believe it was moved to the Roaring Run site sometime in the 1930's.

The bridge is a single span pony truss divided into 4 panels. A complete detailing of its dimensions are provided on sheet 2 of the drawings. All material in the superstructure is wrought iron except for the wooden roadway and the cast iron connectors. All connections are rigid with the main structural members bolted to one another. The tubular arches were formed by riveting 2-horizontal channels together with cover plates. The substructure comprising the abutments is concrete.

The name plate on the bridge indicates it was fabricated by the King Iron Bridge and Manufacturing Co. of Cleveland, Ohio and county records state this same company originally built the structure. Though the first bowstring arch truss was patented in 1841,[2] Zenas King took patents on two variations of the design, one in 1861 (shared by Peter M. Trees) and another in 1866.[3] A bowstring arch truss is essentially a structure in which the horizontal forces exerted by the arch are resisted by flexible ties connected to the ends of the arches at the abutments. Consequently, the top chord of the truss is in compression and the bottom chord is in tension. In constructing a bowstring arch truss bridge, two arch trusses are placed parallel to one another and separated by a distance of 10-20 feet. The roadway is hung directly from the top chords of the arches. Transverse floor beams are attached by flexible rods to the top chord of both arches and span the gap between the arches. These transverse beams support longitudinal girders which in turn, support the wooden planking of the roadway surface. The 1861 patent presented a tubular iron arch bridge primarily distinquished by arches which have "a gradually increasing sectional area from each foot toward the center of the crown". This was intended to provide greater resistance to deflection.[4] The 1866 patent was also directed toward reducing floor sag in a bowstring arch truss but was quite different from his preceding patent. Instead of attempting to increase the strength of the top chord, the 1866 patent proposed a means of tightening the lower chord with nuts attached at the abutments. By turning these nuts the lower chord could be shortened, placing it in greater tension. If excessive sagging occurred in this kind of truss, it could be remedied by adjusting these end nuts. In direct contrast to the 1861 patent, King specifically noted that the top-chord of this truss was to actually have smaller dimensioning at the center of the span.[5]

In examing the actual structure at Roaring Run, it is possible to gain some interesting insight into the nature of early truss design and construction. True to King's 1866 patent the Roaring Run bridge incorporates the nuts attached to the lower chords on the outer surfaces of the abutments to facilitate tightening. However, it is obvious that the top chords of the truss retain a constant cross-sectional area through-out thier length. In a conversion regarding this incongruity between the patented design and the actual structure Robert M. Vogel, curator of Civil Engineering at the Smithsonian Institute, presented a plausible reason for this. He stated that the extra problems and expense involved in forming arches with a varying cross-sectional area were of such magnitude, and the resulting benefits so small, that King probably discarded their implementation because they were not economically advantageous. Though theoretically the greater cross-sectional area at mid-span would provide greater resistance against deflection, in reality King must have found it inadequate. A major clue to the speific reasons for this change may be found in comparing the nature of the deflections described in the two patents. The 1861 patent states that the arch is given greater strength in the center of the span where "an increase of deflection wuld naturally take place". This implies King and Trees assumed the sagging of the bridge was directly dependent upon the intensity of the dead and live loads. They certainly were theorectically correct in this assumption as the weight of the loadings is the cause of the deflections but their proposed remedy apparently proved unsatisfactory.

In the 1866 patent King specifically referred to "atmospheric changes" as being the cause of sagging. Variations in temperature were taken to be the main cause of deflection, not intensity of load. Accordingly, King emphasized the adjustability of his design in response to expansions and contractions due to temperature flucuation. By tightening the bottom chord with the nuts at the abutments, the sagging condition of a bridge could be remedied. Thus, in comparing the two patents, it appears a more practical solution probably grounded in actual construction experience, superseded the initial, theoretical design. This was accompanied by a realization that the 1861 patent incorporated an encomically unsound concept. Through based on these patents, the practical nature of mid-late 19th century bridge construction may be better understood. Though based on rational concepts of structural design, it often reflected personal and intuitive solutions, to the problems encountered in building our nations bridges.

Footnotes

1) _Bedford County Records_, County Courthouse, Bedford VA.

2) Condit, Carl, _American Building Art Vol. 1._ New York: Oxford University, 1960.

3) Patent #33, 384, Oct. 1, 1861 P.M. Frees and Z King
Patent #58,266 Sept. 25, 1866 Z. King.

4) Patent #33,384, Oct. 1, 1861 P.M. Frees and Z. King.

5) Patent #58,266 Sept. 25, 1866 Z King.